Path to Carbon Neutrality:
Ohio State Climate Action Plan

April 2020

THE OHIO STATE UNIVERSITY

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President Michael V. Drake

Dear Ohio State Community and Partners:

The Ohio State University is deeply committed to solving sustainability challenges in our communities and beyond. To be successful, we know we need to address these challenges from multiple angles – from our curriculum and research to community engagement and innovative operations.

The students at Ohio State motivate our actions, and they give me hope on so many fronts. We are educating the leaders of the future. They want to be engaged in addressing the most pressing issues of our time, and climate change is certainly one of the most pressing issues facing us all.

Climate change is most certainly that. Since Ohio State's 2008 commitment to achieve climate neutrality by 2050, and the release of our first Climate Action Plan in 2011, global climate conditions have rapidly escalated into a pending crisis for many communities.

Ohio State continues to take actions to advance scientific knowledge, social understanding, and model operational techniques that will propel new solutions to climate change.

In 2019, Ohio State approved the most significant overhaul of our undergraduate general education requirements in the past 30 years. Our new approach will include a focus on citizenship, with sustainability as a primary theme. This will bring future thought leaders of all backgrounds into a wider discussion on how we can better balance our social, economic, and environmental resources.

We also need to continue to attract the very best scientists and empower their discoveries. I'm proud that Ohio State's oldest research center is the Byrd Polar Climate and Research Center. Since 1960, our scientists have been collecting and preserving

glacial ice cores, some from glaciers that no longer exist. This work continues to help form the bedrock understanding of how humans are changing our climate.

As institutions dedicated to providing affordable and excellent education, we must operate as good stewards, fiscally and environmentally. Our recent public-private partnership in energy management is one way that Ohio State is bringing new expertise and financial resources to meet our energy demand and reduce our carbon footprint.

As one of the largest research universities in North America, Ohio State is committed to creating a deeper understanding of climate change and working with our communities to implement solutions.

This updated Climate Action Plan will help guide our work in the coming years to achieve our carbon neutrality goal, while helping others achieve theirs as well.

Sincerely,

Michael V. Drake

President

President Drake visited with the Ohio State Venturi Buckeye Bullet student team as it attempted to set a new world land speed record at the Bonneville Salt Flats in Utah.

I. Executive Summary

Introduction

For decades, researchers at The Ohio State University and other leading institutions around the world have studied how global climatic conditions are changing as a result of human activity. While the dramatic increase in global energy consumption since the Industrial Revolution has powered incredible advancements for humanity, the associated releases of greenhouse gasses into our atmosphere is threatening our current living conditions.

In fact, the number and severity of changes we are witnessing across the world are outpacing even moderate projected impacts. Forests in the American West are becoming dryer landscapes, feeding increasingly deadly fires, while heavier rain events in the American Midwest and East are driving more nutrient runoff into increasingly warmer freshwater bodies causing more widespread harmful algal blooms.

In an alarming clarion call, the International Panel on Climate Change (IPCC) reported in October 2018 that in order to contain global warming to just 1.5 degrees Celsius, global carbon dioxide emissions would need to be reduced by 45% by 2030 (from 2010 levels), and "net zero" by 2050. Just seven months after that report, in May 2019, atmospheric carbon dioxide exceeded 415 parts per million. That is an unprecedented threshold in modern human history.

It is against this larger social backdrop that Ohio State's commitment to carbon neutrality rises in importance. No single institution, or even country, can solve climate change on its own. Society will have to work collectively, across all sectors and disciplines, to avoid the worst impacts of climate change.

In that context, an institution such as Ohio State can serve as an example and living laboratory of how to achieve mission-oriented growth and success while shrinking its carbon emission footprint. Further, as a land-grant institution, Ohio State is charged with the responsibility to educate the state's citizens and help them implement strategies for wider social success. Addressing climate change through its teaching, research, outreach, and demonstrative actions will help achieve the university's land-grant mission by providing students of all ages and backgrounds with a breadth of awareness, knowledge and skills across disciplinary boundaries to prepare them to be global citizens.

Goal Statement

Over a decade ago, in 2008, Ohio State committed to **achieving carbon neutrality by 2050**.

This public commitment was made by then-Ohio State President E. Gordon Gee through signature onto the American College & University Presidents Climate Commitment, now referred to as the Presidents' Climate Leadership Commitment. Shortly into his new tenure as Ohio State President, Michael V. Drake reaffirmed the university's carbon neutrality commitment in 2015. Later in 2015, Ohio State issued a broader suite of university-wide sustainability goals, with the carbon neutrality goal forming the cornerstone of its operational resource stewardship goals:

> Goal 7a. Achieve carbon neutrality by 2050 per Presidents' Climate Leadership Commitment

The Presidents' Climate Leadership Commitment brings visibility to the issue of climate change and the role of higher education institutions. Currently, over 400 signatories have now committed to a carbon neutrality goal through the Commitment.

Objectives

The Climate Action Plan is an active document, meaning it will be reviewed and updated regularly, that outlines Ohio State's progress and strategy moving forward to meet the carbon neutrality goal.

Within the Presidents' Climate Leadership Commitment, carbon neutrality is defined as "having no net greenhouse gas emissions, to be achieved by either: a) eliminating net greenhouse gas emissions, or, b) by minimizing greenhouse gas emissions as much as possible, and using carbon offsets or other measures to mitigate the remaining emissions."[1]

While the Climate Action Plan details the university's emission sources, trends, accomplishments, challenges, and opportunities for improvement, there are two primary objectives to achieve the carbon neutrality goal:

- **Address University Building Energy Use.** Ohio State's use of electricity, natural gas, and fuel oil for heating, cooling, lighting, and powering its campus buildings accounts for roughly 73% of the university's carbon footprint. Given the different energy sources and ways in which energy is used throughout the campus setting, there is no single action that can be deployed to reduce the university's carbon footprint to neutral. Therefore, a number of strategies and tactics need to be implemented together into a coherent strategy that incorporates financial and social impacts.
- **Address Transportation Related Emissions.** Transportation (all modes, including air travel) accounts for nearly all the university's remaining carbon emissions. However, the majority of those transportation related emissions are generated by faculty, students, and staff driving to the university's various

campuses. This activity is outside of the university's direct control, and, again, no singular tactic will reduce all transportation related emissions. As a result, the university will need to implement numerous tactics to address these emissions.

Recommendations

To achieve the university's carbon neutrality goal, several strategies and tactics will need to be employed in the short and long term. Some will require infrastructure changes, some will involve policy changes, and others still need technological innovation. Collectively, the following recommended tactics form an overall strategy that is intended to be updated and revised as conditions and opportunities change. They identify specific actions to address the two primary objectives and create a new path to offset any remaining carbon emissions that cannot be directly eliminated or mitigated in another manner.

Building Energy Use Tactics

- Execute the energy conservation measures (ECM) program as developed through the Comprehensive Energy Management Program with Ohio State Energy Partners. Consider initiating a new ECM program upon successful completion of current one.
- Comprehensively revise the university Green Build and Energy Policy to more effectively control energy use as the university continues to grow and update its built spaces.
- Implement a new combined heat and power plant (CHP) on the Columbus campus.
- Extend on-campus solar photovoltaics, and any future feasible technology, for increased renewable power generation capacity.
- Complete campus steam network conversion to heating hot water.
- Optimize geothermal sources for heating hot water and chilled water networks and explore new geothermal sources.
- Extend the university's existing level of renewable energy power purchase (preferably solar) and integrate large-scale battery storage for renewable energy generation to meet campus demand.
- Include renewable natural gas ("biogas") within the university's renewable energy purchasing mix to replace conventional natural gas as a fuel source.
- Advance CHP fuel source from natural gas to green hydrogen and/or renewable natural gas.

Transportation Emissions Tactics

- Complete existing university Green Fleet Action Plan and consider further future fuel switch from compressed natural gas to green hydrogen or renewable natural gas.
- Develop a new university financed air travel emissions offset policy.

- Create new incentives to reduce impact of driving to and from campus, including expanding campus user access to electric vehicle fueling stations.

On-Site Carbon Sequestration Mitigation

- Expand campus land management techniques to maximize, and account for, carbon sequestration and additional ecosystem services.

Conclusion

The recommendations detailed in this updated Climate Action Plan position the university to continue to demonstrate leadership in addressing climate change in meaningful ways that provide financial benefits back to the university community and help deliver the promise of an affordable education.

In fact, it may be possible that if the recommendations are fully implemented in the order and timeline described in this Plan, **Ohio State might achieve its carbon neutrality goal as early as 2030 – a full 20 years ahead of goal**, while leveraging 100% renewable energy to power its built infrastructure. This will require institutional dedication and focus, as well as new innovations from internal experts and external partners, and wider market and regulatory changes over the course of the next decade.

However, under a more likely scenario, based on existing technology and financial cost-benefits, Ohio State could still address 55% of its carbon emissions by 2030.

Regardless of when neutrality is achieved, given the broad consequences of climate change, the university should accelerate its pace of activity to demonstrate how action, research, and teaching can ensure a bright future for generations of students to come.

II. Introduction

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Ohio State Climate Action Plan

The university's Climate Action Plan (CAP) is an active document that outlines Ohio State's progress and strategy to meet the carbon neutrality goal.

The CAP details the university's emission sources, trends, accomplishments, challenges, and opportunities. Considered an active document, the CAP is intended to be reviewed and updated regularly to reflect dynamic changes in university operations, regulatory policy, and technological advancements.

Defining Carbon Neutrality

Within the Presidents' Climate Leadership Commitment, carbon neutrality is defined as "having no net greenhouse gas emissions, to be achieved by either: a) eliminating net greenhouse gas emissions, or, b) by minimizing greenhouse gas emissions as much as possible, and using carbon offsets or other measures to mitigate the remaining emissions."

Second Nature. Presidents' Climate Commitment (2015)

Figure 1: Carbon Neutrality Definition, per Presidents' Climate Commitment

Ohio State's initial CAP was formally endorsed in April 2011. While that original Plan provided a high-level overview of the university's Columbus campus carbon emissions and outlined a set of mitigation strategies to address some of those emissions, it did not fully map a path to carbon neutrality. Instead, it focused on where Ohio State should start its efforts towards carbon neutrality and continue to study how the university could achieve its goal.

During the intervening years, the university did adopt several of the initial CAP proposals:

- **Regional Chiller Plants.** In order to deliver chilled water across the Columbus campus in an energy efficient manner, the 2011 CAP recommended establishing two additional regional chiller plants to potentially generate energy savings for chilled water production. The 2011 CAP contemplated moving forward with one of the two in the near term and adding a second plant sometime after 2020. By early 2015, the university had established both, one to serve the Wexner Medical Center and one to serve the Academic Core campus.
- **Geothermal Heating and Cooling.** By 2011, Ohio State already had its first building utilizing geothermal energy, the Nationwide and Ohio Farm Bureau 4-H Center. The initial CAP recommended expanding that effort, specifically to reduce energy use in student residence halls. In 2013, the university completed a project that now supplies five south campus high-rise halls with 100% of their annual cooling and 90% of their annual heating consumption through a 411 geothermal well field network located beneath the South Oval and Hale Green on the Columbus campus.
- **Energy Conservation Measures.** A bedrock action to reducing energy waste and associated financial costs and unnecessary carbon emissions, implementing energy conservation measures and improved energy use metering has continuously occurred throughout Ohio State buildings since the initial CAP was adopted.
- **Transportation Strategies.** The 2011 CAP contemplated ten different transportation related actions to address carbon emissions from the university's vehicle fleet as well as commuters to campus. The university has acted on, and continues to implement, a number of these, including: a Transportation Master Plan, employee incentives for mass transit use, adoption of electric vehicles into the university fleet and related charging stations, and employee incentives for living near campus.

Other actions mentioned within the initial CAP have not been adopted to date by the university, most notably the establishment of a combined heat and power plant at the Columbus campus. However, this will figure prominently in the university's carbon neutrality strategy moving forward.

In addition, the initial CAP did not anticipate a number of significant actions the university took in subsequent years that have helped reduce the university's carbon emissions:

- Established one of the largest individual green power purchase agreements among higher education institutions, for up to 50 megawatts of wind energy capacity to help power the Columbus campus.
- Installed a compressed natural gas fueling station on the Columbus campus to transition the university's bus and vehicle fleet to cleaner burning natural gas fuel.
- Converted some of the university's fleet to electric vehicles and installed a network of electric vehicle charging stations for university fleet and campus community use.

- Implemented bike and scooter sharing agreements to expand access to alternative transportation options to, from, and across the Columbus campus.
- Launched a long-term comprehensive energy management public-private partnership that embeds energy conservation as a contractual goal, provides new funding to implement energy conservation measures, and creates a new center to propel energy research findings into commercialization, among other benefits.

Activity Since 2011 Climate Action

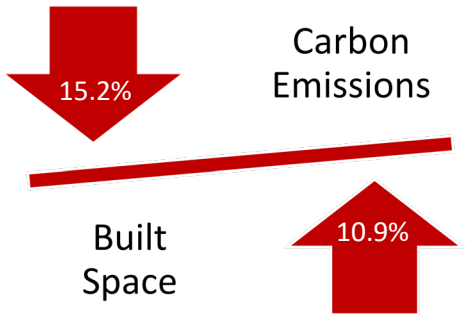

Figure 2: Carbon Emission and Built Space Activity since 2011 Climate Action Plan Adoption.

Altogether, with the implemented recommendations and additional actions, Ohio State reduced its Columbus campus carbon emissions by 15.2% since the initial CAP was adopted in 2011. This reduction occurred over the same time period as the university added over 2.4 million square feet of built space (a 10.9% increase) and improved carbon emission data capture methodologies that generally increased the number of reported emissions in different categories.

Carbon Footprint Boundary Scope

The university's carbon neutrality commitment through the Presidents' Climate Leadership Commitment focused its scope upon Ohio State's Columbus campus. This scope is reflected within the annual carbon emission data reporting the university submits to Second Nature, the third party organization that manages and publishes the Presidents' Climate Leadership Commitments and related data.

Ohio State Properties Not Included in Scope

The following properties are not included within Ohio State's FY19 carbon emission calculations:

- Molly Caren Agricultural Center
- Ohio State East Hospital
- Ohio State Extension offices
- Ohio State University Golf Club
- Stone Laboratory

Figure 3: Ohio State University Properties Excluded from Climate Action Plan Scope and Related Emissions Reporting.

However, in 2015, the university adopted a broader suite of university-wide sustainability goals, and expanded the university's carbon neutrality goal scope to include all of the university's academic campuses: Columbus, Lima, Mansfield, Marion, Newark, and Wooster. The Wexner Medical Center is considered a part of the Columbus campus, and was therefore included in the original 2008 Presidents' Climate Leadership Commitment.

The university does own or operate many properties outside of these academic campuses. For several reasons, these properties are generally not currently included within the scope of the university's carbon neutrality goal. Among others, these reasons include:

- These properties generate de minimis annual carbon emissions.
- Ohio State does not maintain ownership control of the facilities located at these properties.
- Ohio State does not have access to relevant data pertaining to these properties.

III. Greenhouse Gas Emissions Inventory: Emission Sources

In order to establish a long-term strategy towards achieving carbon neutrality, any institution must understand the various individual sources that generate its greenhouse gas emissions. Those individual sources are then grouped by type into widely accepted categories, or scopes. This not only allows the institution to develop specific tactics to reduce emissions by source, it also allows for data comparability across institutions to provide learning opportunities amongst peers for best practices within each emission source scope.

Methodology

To calculate the university's greenhouse gas emissions, Ohio State utilizes the Sustainability Indicator Management & Analysis Platform (SIMAP™). SIMAP is an online tool created specifically for use by higher education institutions to calculate and report their emissions through a common framework. Second Nature, the third party that administers the President's Climate Leadership Commitment, partnered with the University of New Hampshire (UNH) to develop and support SIMAP out of previous emission calculator tools that UNH helped to co-develop. SIMAP is now the most trusted and most used emissions calculator among higher education institutions.

Carbon Dioxide Equivalent Definition

Carbon dioxide equivalent, or CO2e, means the number of metric tons of carbon dioxide emissions with the same global warming potential as one metric ton of another greenhouse gas, and is calculated using a federally defined equation (Equation A-1 in 40 CFR Part 98).

Figure 4: U.S. EPA Definition of Carbon Dioxide Equivalent. https://www3.epa.gov/carbon-footprint-calculator/tool/definitions/co2e.html

SIMAP uses data from many different aspects of campus: campus enrollment, building area, campus-owned fleet data, purchased electricity, electric grid source composition, student and faculty transportation data, fertilizer usage, and waste management, to name a few. The input data is collected through various methods by the university: direct meters, billing data, university-wide surveys, etc.

Once the university's raw data is input to SIMAP, the program runs a series of calculations to convert each greenhouse gas emission source and amount into units of carbon dioxide equivalents (CO_2e), for a common measurement across emission sources. Each source, and its related CO_2e is then categorized into a wider, commonly accepted, scope:

Scope	Definition	Source
Scope 1	Direct Emissions	From sources directly owned or controlled by the university. Examples include on-site fuel combustion and fleet vehicle fuel consumption.
Scope 2	Indirect Emissions	From sources indirectly owned or controlled by the university. Examples include the generation of purchased electricity, heat, or steam.
Scope 3	Emissions Related to University Activities	From sources not owned or directly controlled by the university. Examples include student and employee travel and commuting, and waste disposal and treatment.

Figure 5: Greenhouse Gas Emissions Scope Definitions, Adapted from U.S. EPA
https://www.epa.gov/greeningepa/greenhouse-gases-epa

The definitions of these scopes imply the following:

- If the university's campus community and business partners are committed to their own sustainability actions, the university's Scope 2 and 3 emissions will reduce with their improvements.
- As the scope increases from 1 to 3, data collection becomes increasingly difficult and the accuracy of the calculation decreases.
- It is extremely difficult to collect every piece of data needed for a complete Scope 3 assessment. Thus, there is a need to continuously review and evaluate data gaps and their potential impacts.

Results

In Fiscal Year 2019, Ohio State's total greenhouse gas emissions equaled 619,944 tonnes CO2e within the annual greenhouse gas emissions inventory. Not surprisingly, of the university's six academic campuses, the Columbus campus generated the most emissions, accounting for 568,985 tonnes CO2e, or 91.8% of the university's total emissions (Figure 6).

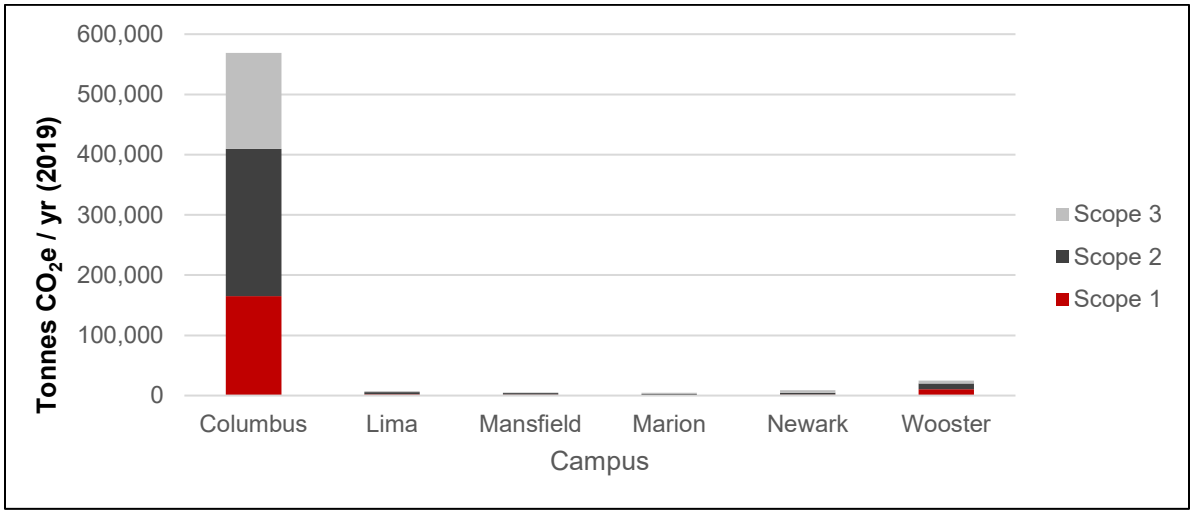

Figure 6: Carbon Footprint Results for Each Campus in Fiscal Year 2019.

Due to the scale of operations for the Columbus campus, and resulting percentage share of greenhouse gas emissions, this CAP will largely focus on information and solutions most applicable to the Columbus campus, although much could apply to all the campuses on different scales.

That said, more than 40% of the university's overall total greenhouse gas emissions (264,718 tonnes CO2e) in Fiscal Year 2019 were generated from the university's purchased electricity, heat and steam within Scope 2. The remaining emissions were nearly evenly split between Scope 1 and Scope 3 emissions, at 29.4% and 27.9% respectively, of the university's total emissions.

Scope	CO2e Metric Tonnes	Percentage of Total Emissions
Scope 1	182,044	29.4%
Scope 2	264,718	42.7%
Scope 3	173,182	27.9%
Total	619,944	100%

Figure 7: Fiscal Year 2019 Greenhouse Gas Emissions by Scope.

Recent Emissions Trend

Since the university established its suite of sustainability goals in 2015, the university has increased its reported annual carbon emissions by 4,892.77 tonnes CO2e, or 0.8% (Figure 8).

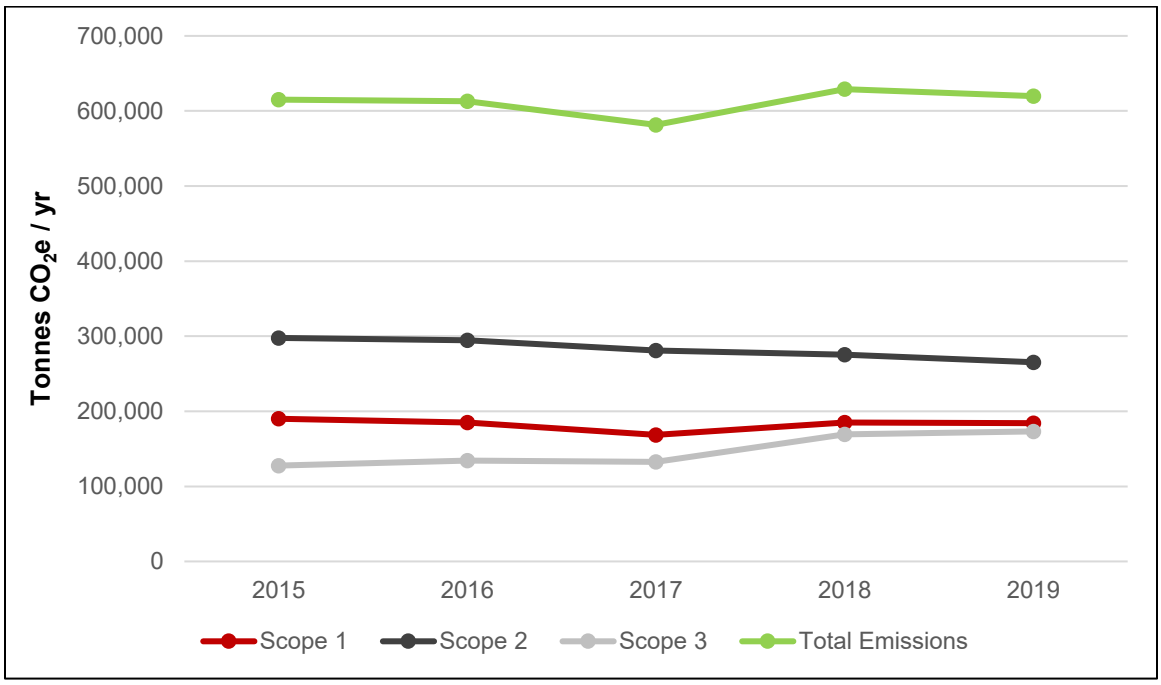

Figure 8: Total University Carbon Footprint Results from 2015-2019.

The overall increase in reported emissions during this time frame is largely the result of improved data collection and monitoring efforts, particularly as the university was able to capture additional emissions records, beginning in Fiscal Year 2018, that were not previously available. Namely, directly financed university air travel emissions are now more holistically included in the university's annual carbon emissions record keeping and reporting than they were in previous years.

In addition, the 10.9% decline in Scope 2 emissions from Fiscal Year 2015 through Fiscal Year 2019 reflect a number of factors, including the implementation of energy conservation measures particularly through the Comprehensive Energy Management Project with Ohio State Energy Partners, the improved fuel mix associated with the electrical grid ("grid greening"), and the university's significant, long-term investment in renewable energy supply to the Columbus campus from the Blue Creek Wind Farm, which has helped maintain a lower plateau of Scope 2 emissions since 2013.

University Emissions by Source

Understanding what sources contribute to the university's greenhouse gas inventory, at what levels, is critical to developing a successful strategy to achieve carbon neutrality. Mapping the source breakdown of emissions helps the university identify the highest priority sources to address and provides a starting point for considering what tactics would be most effective to employ against each source.

As noted above, emissions generated from the purchase of electricity represent the single largest source of emissions for the university. That is followed by on-campus stationary sources (e.g. combustion of natural gas at McCracken Power Plant to supply heating and process steam), then a series of transportation related emission sources (Figure 9).

Although energy and transportation emissions make up the majority of the university's carbon footprint, it is important to see how many different sources contribute greenhouse gas emissions. For this reason, commitments and actions from across all areas of the university will be necessary to achieve carbon neutrality.

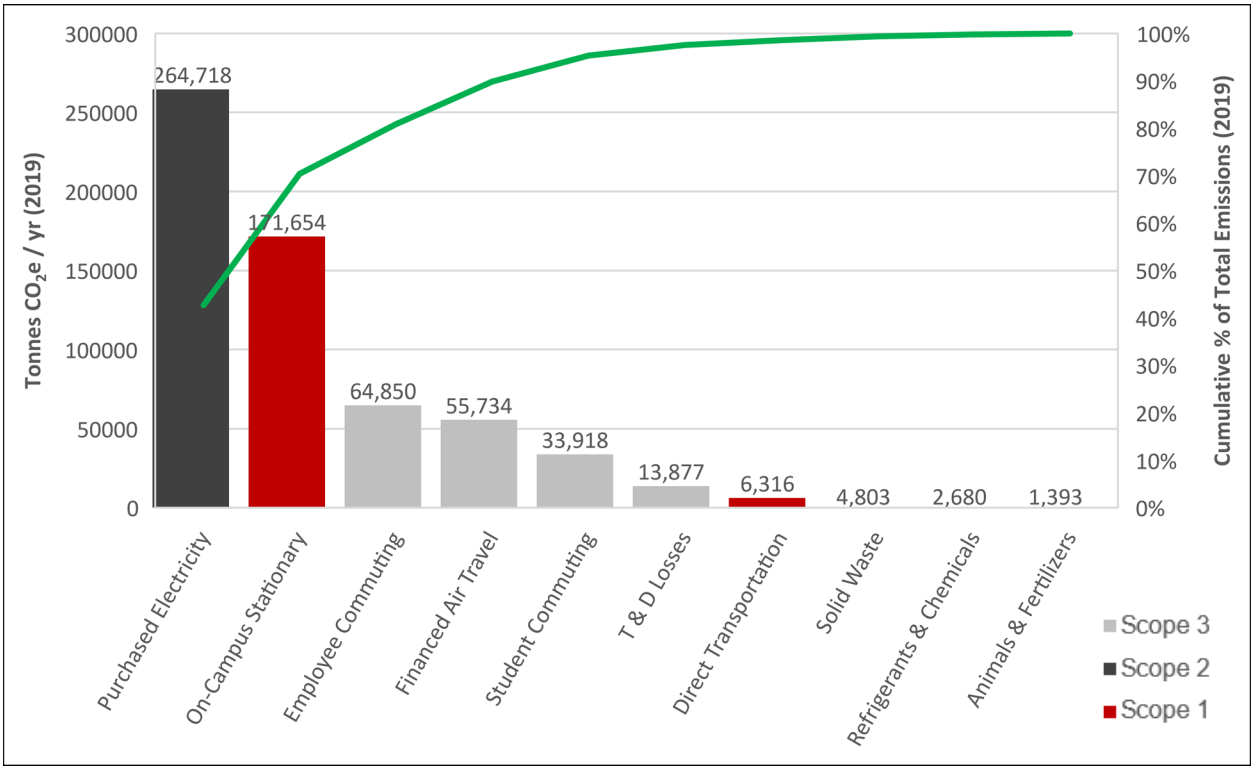

Figure 9: Distribution of University Carbon Emissions by Source in Fiscal Year 2019.

University Emissions Trends by Source

Just as it is important to understand the university's emissions by individual source, and the overall long-term trajectory of total emissions, it is important to understand the emissions trends within individual sources. This helps the university understand how operational changes or improved data collection efforts affect a targeted source's emissions. The figure below demonstrates the university's emissions by source for the five-year period beginning with 2015 and ending with 2019 (Figure 10).

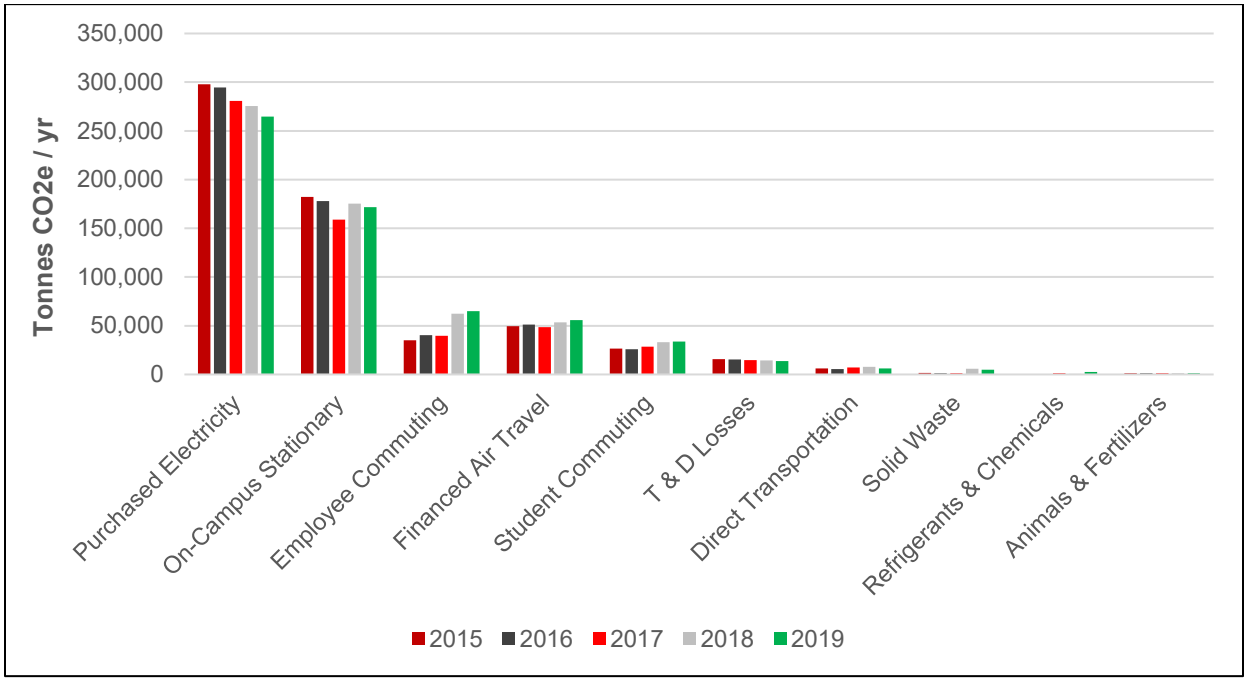

Figure 10: Distribution of University Carbon Emissions by Source from 2015-2019.

IV. Operating Framework for Progress

As stated in the university's previous Climate Action Plan:

> *Achieving climate neutrality will require aggressive reductions, avoidance, and neutralization in existing and future greenhouse gas emissions. One thing is clear – there is no single solution. Many strategies will need to be implemented to meet the overall goal.*

While this is still true, it is clear that the university will need to emphasize strategies that address building energy use and transportation-related emissions, given the dominant roles those two sectors have in the university's total emissions footprint. In order to organize those tactics into an operating framework, Ohio State will follow the carbon management hierarchy, presented in the *Second Nature Carbon Markets and Offset Guide*.[2]

Further, while this Climate Action Plan identifies a set of recommendations for Ohio State to implement in the short and near term, the university will adaptively manage its resources and programming towards achieving carbon neutrality. In that sense, this is a "living" document, one that will change with societal, economic, technological, and public policy changes over time.

Finally, it is also important to note that electric utility driven "grid greening" is anticipated to continue, which will benefit Ohio State's carbon footprint regardless of actions the university takes. In fact, Ohio State's current primary electricity utility provider, American Electric Power (AEP), has publicly committed to accelerating its carbon emission reduction goals, in order to achieve an 80% emission reduction by 2050, measured from a 2000 baseline. While that activity is clearly outside of Ohio State's control, it could have a direct beneficial impact to the university's carbon neutrality efforts.

Carbon Management Hierarchy

1) **AVOID** New Emissions
2) **REDUCE** Existing Emissions
3) **REPLACE** Sources of Emissions
4) **OFFSET** Remaining Emissions

This hierarchy is not meant to act as a list of competing or restricting strategies, but rather to consider the value of different actions to meet carbon neutrality. Essentially, this hierarchy promotes behavioral changes which avoid carbon emissions altogether over technological or market-based solutions. However, it is better to act urgently than it is to debate the ranking and implementation of the hierarchy. Any action to reduce emissions is better than none.

Avoid – Minimize Consumption

The top priority towards becoming a carbon neutral university is to avoid emissions and carbon-intensive activities altogether. This means avoiding unnecessary use of electricity, process steam, heating and cooling, and transportation among other sources of emissions. This may also mean avoiding a new project if it does not align with the mission of the university or designing projects to avoid carbon emissions once they are completed. Most of the avoidance opportunities are subject to human behavior and show a need for a strong culture across Ohio State that is committed to its sustainability initiatives.

Reduce – Improve Efficiency

Maximizing the efficiency of the university's current operations will help reduce emissions. This category of the hierarchy will include most of the recommended technological changes.

Replace – Cleaner Energy Sources

Replacement involves substituting high-carbon energy sources with low-carbon or renewable energy sources. This can include both on-site and off-site energy generation. This can also include procurement of renewable power, such as solar or wind power, paired with battery storage to cover intermittency of renewable power generation. Also, the development or procurement of renewable natural gas can replace or offset conventional natural gas usage.

Offset – Obtain Certified Credits

Within the hierarchy, offsetting greenhouse gas emissions is an effort of last resort towards carbon neutrality. Offsets can occur in distinctly different ways, but generally involve investing in projects that either directly sequester emissions or displace existing emissions. While either option results in a similar outcome (the generation of certified credits), these are considerably different routes to offset emissions.

- **Direct Sequestration.** Projects that sequester emissions require third party certification to verify the intended emissions are sequestered. Carbon

Carbon Sequestration "Sinks"

Just as human activities emit carbon, nature has many ways of sequestering carbon as part of the carbon cycle. For the Climate Action Plan, Ohio State will consider the land which sequesters carbon as "sinks," or negative emissions compared to carbon sources. The impacts of climate change are a result of releasing more carbon into the atmosphere than the natural world has capacity to sequester. Therefore, instead of solely focusing on reducing emissions, the university will seek to include natural sequestration in the assessment of the Plan. The two main sinks that will be considered in the university's carbon sequestration analysis are: **tree canopy** and **soil**. Carbon sequestration can occur above and below ground as part of ecosystem growth, such as through the process of photosynthesis. For tree canopy, the species, size and age of the tree(s) are most important for determining the rate of carbon sequestration. For soil, several different measurements are necessary, including soil organic carbon (SOC), the biomass above ground, climate, and others.

For more detail on the sequestration calculations, see Recommendations.

Figure 11: Definition of Carbon Sequestration Sinks

sequestration projects can be designed to improve local landscapes and cultivate long-term future value, creating “carbon sinks.”

- **Emission Displacement.** Projects that involve displacing existing emissions typically involve the purchase of renewable energy credits (RECs), which are available in a variety of forms in a variety of markets. However, REC purchases must be replenished on an annual basis to maintain equal displacement of continuously generated emissions.

“Living” Document and Measuring Progress

To measure progress moving forward, the university will commit to updating the Climate Action Plan every five years. The Climate Action Plan will assess how far the university has come towards its commitment to climate neutrality and reevaluate its plan and recommended tactics to meet the goal by 2050, if not earlier.

The greenhouse gas inventory will be reassessed annually, publicly reported through the Presidents’ Climate Leadership Commitment reporting platform, and communicated through the variety of entities already in place at the university that focus on sustainability, including the President and Provost’s Council on Sustainability, Sustainability Institute, Energy Services and Sustainability, and Resource Stewardship Working Group.

V. Recommendations

Using the carbon management hierarchy as an operating framework, the following action recommendations seek to address the university's currently feasible opportunities to achieve carbon neutrality across primary sector use, the three scopes of greenhouse gas emissions, and implementation timeline.

Avoid – Minimize Consumption

- **Update University Green Build and Energy Policy.** Currently, the university policy requires building projects valued at $4 million or above to achieve LEED Silver certification. While this policy has advanced the university's overall sustainable building design criteria since its adoption, there may be more direct ways to achieve the university's sustainability goals, including carbon neutrality. The university should update the existing policy to ensure that building and construction projects are designed in a manner that utilizes energy as efficiently as possible for the intended purpose in the project's post-construction operation. This university-wide policy update should be informed by the work conducted in Fiscal Year 2019 to develop updated sustainable campus building standards specifically for the Time and Change: Building the Future construction projects, which included stronger energy efficiency recommendations than the existing university Green Build and Energy Policy.
  When: Short Term – 1-2 Years (FY20-21)
  Sector: Building Energy Use
  GHG Scope: 1 & 2
  Emissions Reduction: Will vary by building project
  Financial Cost Impact: No direct cost impact for policy revision, but updated policy will have varying upfront and lifecycle cost impacts, with a goal to lower overall cost of ownership.

- **Advance and Promote Teleconferencing and Remote Meetings.** The university is in the process of broadly adopting tools such as *Skype for Business* and *Microsoft Teams* that should enable increased distance-meeting capabilities. This opens new avenues to reduce travel related costs and greenhouse gas emissions. The university should provide appropriate user training for these tools and identify specific in-person meetings with internal or external partners to participate via teleconference, with an emphasis on those currently requiring university financed airline travel.
  When: Short Term – 1-2 Years (FY20-21)
  Sector: Transportation
  GHG Scope: 1 & 3
  Emissions Reduction: TBD
  Financial Cost Impact: Expected cost savings

- **Foster Energy Conscious Culture.** As the university has conducted a variety of educational campaigns on other sustainability topics, there are opportunities to demonstrate to the campus community how behavioral change can help reduce the university's emissions footprint. While these activities can be manifested in many different ways, new programming would benefit from engaging the university's behavioral change researchers to help design and implement effective, science-based behavioral interventions.
  When: Short Term – 1-5 Years (FY20-25)
  Sector: Building Energy Use, Transportation
  GHG Scope: 1, 2 & 3
  Emissions Reduction: TBD
  Financial Cost Impact: Expected cost savings

Reduce – Improve Efficiency

- **Implement Energy Conservation Measures.** Under its partnership with Ohio State Energy Partners (OSEP), the university is positioned to significantly increase energy efficiency efforts across the Columbus campus. In coordination with university staff, OSEP develops and proposes energy conservation projects on an annual basis to the university Board of Trustees. The university must approve those projects. Under the terms of the partnership agreement, OSEP is obligated to improve the university's Columbus campus energy efficiency by a minimum of 25% by June 2028, and further support improvement in energy efficiency beyond that amount through the life of the partnership (June 2068). In addition, the partnership agreement envisions developing new energy efficiency targets and incentives every ten years following the first 25% efficiency target. Finally, the university will ensure the energy conservation projects operate as designed to retain long-term energy efficiency benefits through a focused preventative maintenance and retro-commissioning program.
  When: Short to Long Term: 1-8 years (FY20-FY28)
  Sector: Building Energy Use
  GHG Scope: 1 & 2
  Emissions Reduction: 75,000 tonnes CO_2e, 12% of total emissions
  Financial Cost Impact: $250 million capital investment through CAPEX, with each ECM project providing positive net present value to Ohio State

"CAPEX" Definition
Capital expenditures are institutional investments into physical assets. These physical assets include, among other items: buildings, roadways, vehicles, land and related infrastructure. "CAPEX" is a well-established abbreviation for capital expenditures and is used within this Plan to demonstrate the expected capital expenditure amount for executing some of the recommendations.

Figure 12: "CAPEX" Definition

- **Construct Combined Heat and Power Plant.** Following a feasibility study conducted by OSEP, the university Board of Trustees has approved construction

for a combined heat and power (CHP) solution on the Columbus campus. The plant is sized to level the cost of energy for the university and designed for flexible operation to meet the university's dynamic energy needs and campus resiliency. Heat resulting from the power production is used to produce steam, which can either be fed to the existing campus district steam heating network, used in the new campus district hot water network, or directed to generate power in a steam turbine.
When: Short Term: 1-3 years (FY20-FY22)
Sector: Building Energy Use
GHG Scope: 1 & 2
Emissions Reductions: 148,000 tonnes CO_2e, 24% of total emissions
Financial Cost Impact: $290 million capital investment through CAPEX, expected lifecycle cost savings

Replace – Cleaner Energy Sources

- **Continue to Implement University Green Fleet Action Plan.** Along with its carbon neutral goal, the university has established a goal to reduce the carbon footprint of its fleet by 25% by 2025. Led by the Office of Transportation and Traffic Management (TTM), this effort includes "right-sizing" the university fleet, converting the fleet to alternative fuel vehicles, and the incorporation of increasingly carbon friendly fuel sources. As TTM continues to execute the plan's fleet conversion to compressed natural gas and electric vehicles, the university should achieve a 15% reduction in fleet related emissions. Achieving the additional 10% reduction to reach the fleet goal will require additional planning and solutions, given the currently prohibitive pricing for less intensive fuel sources. Given this, for Climate Action Plan purposes, the latter is not currently included in the emissions reduction figure below.
  When: Short to Medium Term: 1-6 years (FY20-25)
  Sector: Transportation
  GHG Scope: 1
  Emissions Reduction: 1,160 tonnes CO_2e, 0.2% of total emissions
  Financial Cost Impact: TBD

- **Expand Campus User Access to Electric Vehicle Charging Stations.** In addition to the university owned fleet, TTM has been actively seeking to expand university user access to electric vehicle charging stations. This includes work to develop a user access policy (including fuel pricing), and strategic placement of charging stations to leverage maximum use. Depending on electric vehicle adoption rates within the university community, this effort will help reduce the university's greenhouse gas emissions related to employee and student commuting but may slightly increase purchased electricity related emissions. For the purposes of estimating emissions reductions within this plan, the Smart Columbus 1.8% adoption rate projection was applied to employee and student commuting generated emissions.
  When: Short to Medium Term: 1-6 years (FY20-25)

Sector: Transportation
GHG Scope: 3
Emissions Reduction: 1,700 tonnes CO_2e, 0.3% of total emissions
Financial Cost Impact: TBD

- **Explore Campus-Based Solar Energy Generation.** Currently, Ohio State has a few solar arrays across its campuses, most notably the "Block O" rooftop array on the RPAC and the more recent rooftop installation on the Marion campus Science and Engineering Building. Unfortunately, there are surprisingly few campus locations that could feasibly host an economically sound solar array. Ohio State's existing building stock presents considerable challenges for rooftop solar mounting – ranging from appropriate roof strength, to historical architecture, to lack of south-facing roofs, among other considerations. As a result, ground mount systems are likely more physically feasible, but will be difficult to implement due to the constantly changing nature of the university's land assets. The university should continue to monitor opportunities to install solar energy generation on campus, particularly as economic conditions change, and long-term sites are identified. By 2030, it might be possible to install a modest amount of solar energy generation the university's campuses, on the order of 10 megawatts. Beyond any potential future energy cost savings and carbon emission reductions, on-site solar energy generation would provide increased educational and outreach opportunities.
  When: Short to Long Term: 1-11 years (FY20-30)
  Sector: Building Energy Use
  GHG Scope: 1
  Emissions Reduction: 6,100 tonnes CO2e, 1% of total emissions
  Financial Cost Impact: $24 million capital investment through CAPEX, expected energy cost savings

- **Advance Green Hydrogen and/or Green Biogas Fuel Replacement.** The proposed combined heat and power plant will achieve both energy efficiency and a carbon emission beneficial fuel switch from grid energy to natural gas for most of the university's power generation. However, natural gas still generates carbon emissions. Among other private sector energy entities, OSEP's operating entity on campus, ENGIE, is currently developing hydrogen and biogas fuel solutions as a replacement source for natural gas. This includes "green hydrogen," which can be generated through the electrolysis of water using renewable electricity resources. Generally, this requires the consumption of water as the basic fuel feedstock. So, siting this type of energy operation would need to ensure the appropriate body of water could sustain the necessary level of consumption withdrawal. Ohio State's energy research experts have already begun a dialog on how the university's academic assets could help advance hydrogen technology for quicker, and more sustainable, adoption. Recognizing the significant market based and regulatory challenges that would enable green hydrogen to be a viable fuel source, the current pace of research progress is

encouraging. In fact, the university's planned Energy Advancement and Innovation Center, which will be established in partnership with ENGIE, could be a significant driver to advance green hydrogen adoption, and help make it a viable fuel replacement at some level for Ohio State's CHP in/around 2030. The university should continue to explore with OSEP how to advance this development and leverage the Energy Advancement and Innovation Center as a location to house this collaboration. "Green biogas" is produced by decomposition of waste feedstocks, including agricultural and post-consumer waste. Emerging opportunities to leverage ENGIE's experience with green biogas have been explored through a pilot project with the university and should be continued to advance development suited for the university's unique waste streams.
When: Long Term: 10 years (FY30)
Sector: Building Energy Use
GHG Scope: 1
Emissions Reduction: 340,000 tonnes CO2e, 55% of total emissions (full replacement of conventional natural gas fuel source)
Financial Cost Impact: Hydrogen costs are nearly 40 times the cost of natural gas in 2019 and are not feasible for consideration at this point. Technological advances are expected in the coming decade to reduce the cost of green hydrogen production. Green biogas processes are limited by the available waste streams. As the university continues to enhance its ability to separate post-consumer waste and manage agricultural and dining waste, onsite or near-site green biogas may become increasingly feasible.

- **Increase Renewable Energy Procurement.** As the university experiences electricity use efficiencies through energy conservation measures and the CHP, the university should explore additional renewable energy procurement in an amount that is compatible for optimal leverage of the CHP capacity. Based on CHP operations, the remainder of the imported grid electricity could be provided through renewable procurement. Given the university's energy use pattern, it would be preferable for the additional renewable energy to be solar generated. Solar energy generation matches the university's daytime energy use loads closer than wind energy generation, which generates more energy overnight that would require additional energy storage capacity for university use. Battery storage systems could be included to cover the variability in solar generation. Further, renewable natural gas ("biogas") to replace conventional natural gas burned in the CHP could also be a pathway to increase renewable energy supply for the university.
  When: Medium Term: 3-5 years (FY22-24)
  Sector: Building Energy Use
  GHG Scope: 2
  Emissions Reduction: 30,000 tonnes CO2e, 4.8% of total emissions (replacement of purchased electricity from the grid); 340,000 tonnes CO2e, 55% of total emissions (full replacement of natural gas fuel source for CHP)

Financial Cost Impact: Incremental energy costs for solar are 15-20% higher than current purchased electricity from the grid. The competitive renewable natural gas ("biogas") market has not been explored for this purpose as of the release of this document.

- **Extend Existing University Commitment to Renewable Energy.** In 2012, Ohio State became one of the largest purchasers of renewable energy among higher education institutions. Through this 20-year purchase agreement with the Blue Creek Wind Farm, that wind energy accounted for approximately 14% of the university's total energy purchase in Fiscal Year 2019. This agreement drove a reduction of approximately 85,000 tonnes CO_2e in the university's Columbus campus annual emissions. The existing agreement will end in Fiscal Year 2033. Closer to the end of that agreement, the university should develop a plan to extend or replace that level of renewable energy purchase.
  When: Long Term: 13 years (FY33)
  Sector: Building Energy Use
  GHG Scope: 2
  Emissions Reduction: Not applicable
  Financial Cost Impact: TBD

Offset – Obtain Certified Credits

- **Develop University Air Travel Policy.** Recognizing the greenhouse gas impact of university related air travel, some higher education institutions have begun implementing policies to offset these emissions, which are largely beyond the university's control. Ohio State's most significant air travel use categories include its academic research and learning efforts, which are integral to the university's reputation and student experience. As other institutions realize successes in their travel policies – ranging from requiring ground transportation within a certain distance to implementing flat fees per flight – Ohio State should develop a program to offset its annual air travel related emissions that fits the university's culture.
  When: Short Term: 1-2 years (FY20-21)
  Sector: Transportation
  GHG Scope: 3
  Emissions Reduction: 55,734 tonnes CO2e, 9% of total emissions
  Financial Cost Impact: $280,000 annually (based on $5.00 average carbon offset cost per metric tonne)

- **Enable Carbon Sequestration Through Campus Land Management.** As mentioned in the Carbon Management Hierarchy above, natural landscapes have the capacity to sequester carbon. In moving towards neutrality, it is important to consider efforts to increase the sequestration capacity of campus lands in parallel with mitigating emissions. Ohio State can increase its sequestration rates across all six university campuses through increasing tree canopy and land use management techniques focused on sequestration.

Current rough estimates of average reforestation projects have been found to cost 5-19 $/tonnes CO2e. Looking at the potential of carbon sequestration for Ohio State campuses, two cases were considered. The first case (Potential I), considers no change in land-use, but rather beneficial land management practices identified by research findings to which Dr. Rattan Lal has significantly contributed. These management practices affect the soils of grasslands, croplands, and forest, such as: fertility management through liming and mineral fertilizers, application of local manure, planting improved and native plant species, erosion reduction, longer crop rotations, and partial cutting versus clear-cuts, to name a few. The second case (Potential II) includes land-use change. To prevent competition between food production and carbon sequestration, the land-use change scenario does not consider a decrease in crop and agricultural land, especially since most of this land is used for the university's agriculture research. It also does not consider the change of all grasslands (lawns) to forest or tree cover. Changes in sunlight absorption due to different land cover or emissions by trees are not included in this analysis. Although it is an extreme scenario to consider a complete conversion of grassland to forest, it does best show the potential of land use change to meet the goals of carbon neutrality. The results of carbon sequestration associated with these scenarios are shown in Figure 14 and Figure 15. Figure 14 shows total sequestration as a rate in the same units as presented in the greenhouse gas emissions inventory. Figure 15 shows these results as a fraction compared to the Scope 1 emissions in Fiscal Year 2019 by campus location, as to compare the carbon directly emitted on each campus with that being sequestered by the surrounding land – Scope 1 positive and negative emissions.

Calculating Sequestration

To calculate the rate of tree canopy sequestration across Ohio State campuses, a data set of over 15,000 trees on the Columbus campus was used as a sample population. Using the Urban Forest Effects- Dry Deposition (UFORE-D) model[3] built into iTree Eco[4], the amount of carbon sequestered per unit of tree coverage area [tonnes CO2 / acre] was calculated. Then, using GIS data and campus maps, this value was scaled to the amount of tree covered land area across the different campuses.

To calculate soil sequestration, a collection of research from Ohio State's Dr. Rattan Lal and collaborators[5,6,7] provided estimates of U.S. soil sequestration for three different land uses: forest, cropland and grazing land. The literature provided current analysis of carbon sequestration of these land types across the U.S. along with future potential sequestration given a variety of different management strategies. The soil sequestration data from the given literature was normalized and scaled to reflect the land-use of each campus. The same GIS data used for tree area was used to determine crop and grassland area across the different campuses.

Figure 13: Methodology for Calculating Carbon Sequestration

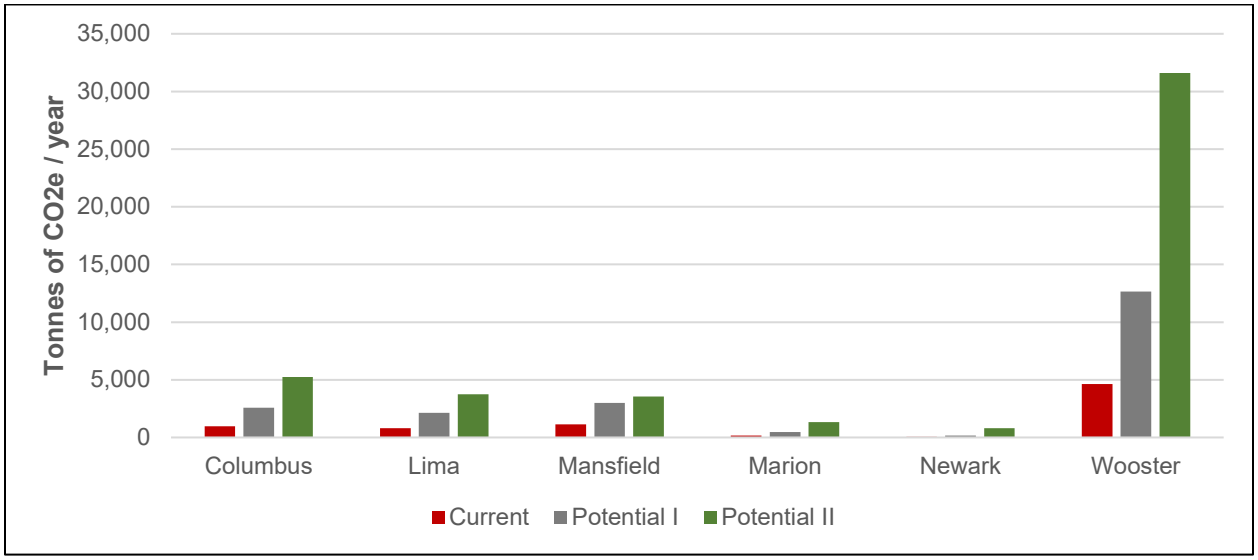

Figure 14: Scenarios of Sequestration, Shown as Amount of CO_{2e} Annually Sequestered.

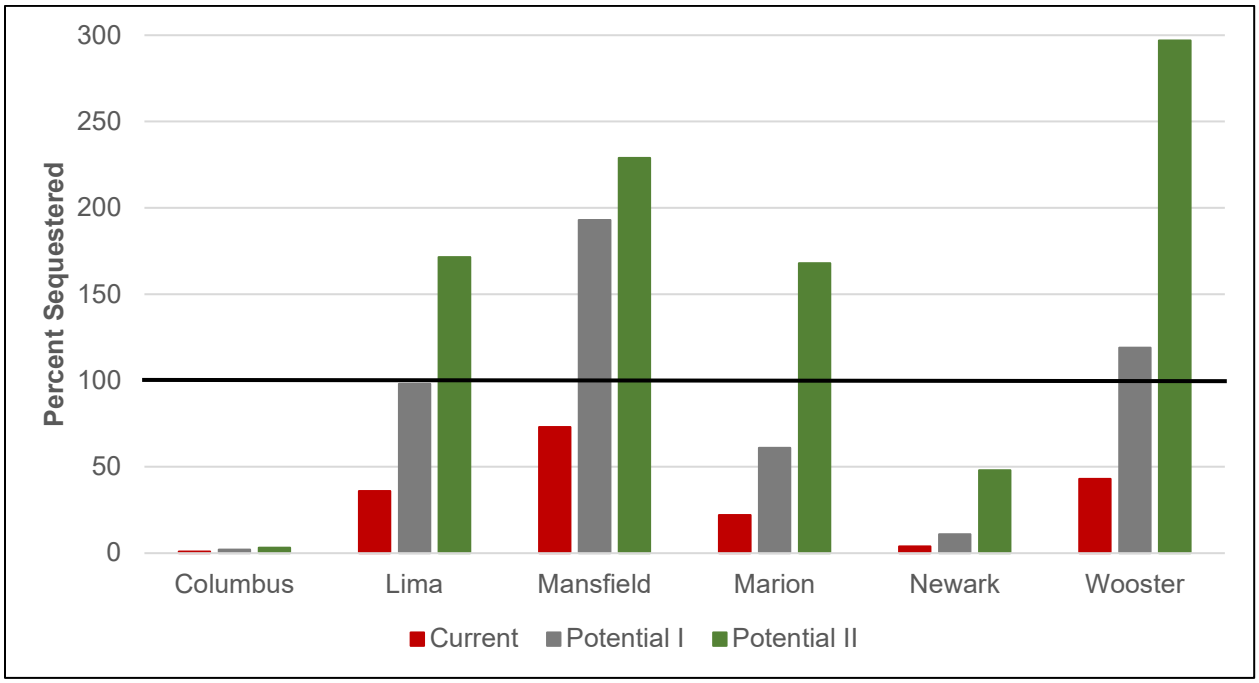

Figure 15: Scenarios of Sequestration, Shown as Percent Sequestered of Scope I Emissions of Each Campus.

Under these scenarios, the sum of the sequestration across all campuses is:

Scenario	CO2e Metric Tonnes Sequestered	Percentage of Total Emissions
Current	7,750	1.25%
Potential I	21,000	3.4%
Potential II	46,250	7.5%

Figure 16: Carbon Sequestration Potential Comparison

Outside of just Potential I and Potential II, an unlimited number of scenarios exist and could include multi-purpose land use, such as green roofs or parking lots. Adding to the feasibility of investing in the natural land on Ohio State property, projects funded as offsets could occur either on or off campus, as long as they are in addition to "business as usual." Land use changes take time to grow and they produce more sequestration with time. Therefore, more immediate adoption would enable the possibility to reap the benefits sooner. Such changes in land use will also provide other ecosystem services such as air quality regulation, water provisioning, climate regulation, and recreation. Therefore, Ohio State should cultivate peer institutions in a broader effort to enable SIMAP to consider and allow appropriate carbon sink projects as a recognized greenhouse gas emission offset. Further, the university should pursue the available land use and land management techniques to maximize carbon sequestration opportunities as closely aligned to the Potential II scenario outcome as possible.

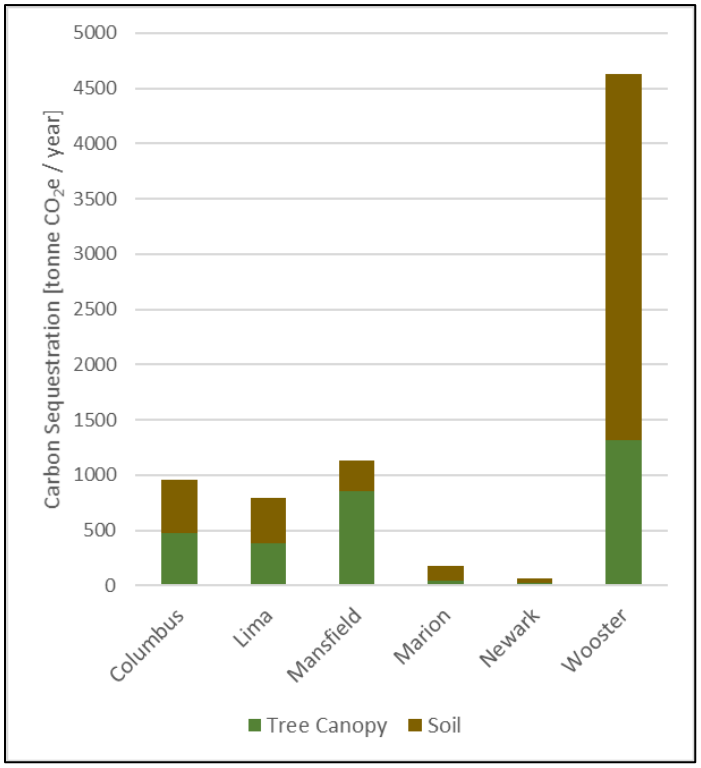

Figure 17: Carbon Sequestration Results for Soil and Trees on Each Campus.

When: Short to Mid Term: 1-6 years (FY20-25)
Sector: Carbon Sequestration
GHG Scope: 3
Emissions Reduction: 46,250 tonnes CO2e, 7.5% of total emissions
Financial Cost Impact: $231,250 - $878,750 annually (based on estimated per acre ecosystem restoration/carbon sequestration figures)

VI. Integrated Plan

As stated above, there is no single solution for the university to achieve carbon neutrality. Many strategies will need to be implemented to meet the overall goal. This is especially important to keep in mind because Ohio State is one of the largest universities in the country. Each member of the Ohio State community can play a role in the goal of carbon neutrality, showing the value of a campus culture committed to sustainability. This campus culture may be as important as the operational decisions made by university leaders.

While there are many ways to achieve carbon neutrality, one item is clear: the university needs to continue to take meaningful actions now in order to achieve the goal. Also, it is equally important to continue discussion of bold actions and possibilities as it is to develop realistic and clear next steps. This keeps implementation activities moving forward while opening the door to new possible opportunities.

Figure 18 showcases the impact of pursuing some of the options presented in this Plan, including the impact of the Comprehensive Energy Management Partnership (CEMP) and the relative utility emissions footprint in various scenarios for the Columbus campus. The CEMP includes implementing the energy conservation measure program on the Columbus campus. Figure 18 also demonstrates the limitations of options for emissions mitigation. For example, if the university had chosen to procure renewable energy credit offsets for all its electricity demand in Fiscal Year 2019, the emissions footprint of the university's utility heating would remain a substantial source of overall emissions. Therefore, in order for the university to meet its carbon neutrality goal, a suite of actions is necessary, including pursuit of new power sources and renewable energy procurement in the near future (2-10 years) and a longer-term switch to alternative fuel sources (such as green hydrogen or renewable natural gas/biogas) when available in the mid- to longer-term future (15-30 years). Figure 18 shows one feasible future scenario of many the university could pursue to achieve carbon neutrality within its Columbus campus utility system.

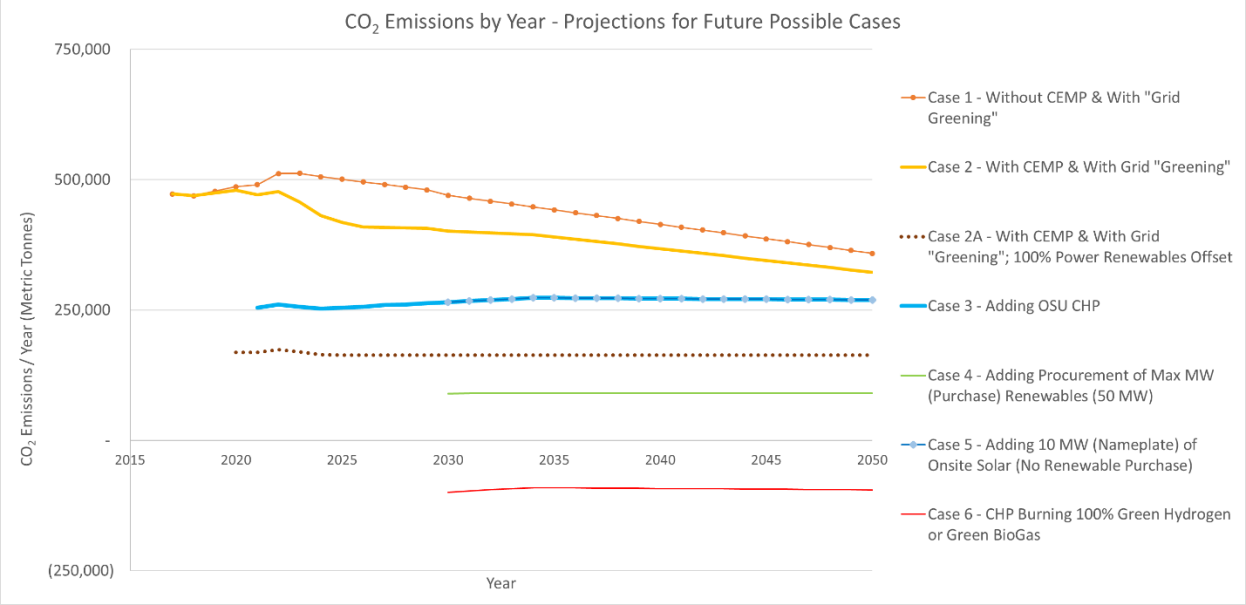

Figure 18: Carbon footprint comparisons of current and future utility energy footprint for the Columbus campus.

The recommendations within this Plan outline a scenario where the university could achieve its carbon neutrality goal, and potentially become *carbon positive*, by 2030. Added together, the recommendations would reduce, replace, or offset 703,944 tonnes CO_2e on an annual basis, compared to the university's Fiscal Year 2019 emissions of 619,944 tonnes CO_2e.

Figure 19 demonstrates how the separate recommendations within this Plan add up to that conclusion, by emission source Scope. This includes moving to green hydrogen as a fuel source for the combined heat and power plant, which as a cleaner fuel source than the existing electric grid, could generate excess carbon credits for the university beyond what is necessary to power university operations. Similarly, as shown in Figures 18 and 19, the university's Scope 2 emissions might be more than fully reduced or offset by a combination of increased energy efficiency and further utilization of renewable energy (through purchase and on-site generation).

Figure 20 demonstrates an alternative scenario that does not include green hydrogen as a fuel source for the combined heat and power plant, but rather, moving from conventional natural gas to renewable natural gas. In this case, the university is unlikely to generate any excess carbon credits and would more likely simply reduce the related emissions on a one-to-one basis. In this scenario, the university could still achieve an 86.4% emission footprint reduction from Fiscal Year 2019 levels. The remaining gap, less than 85,000 tonnes CO_2e, could be addressed through the purchase of offsets to achieve climate neutrality.

Considering the available options, then, carbon neutrality is achievable for Ohio State, but will require substantial, continuous actions, including the development of new technology and infrastructure. These actions will also have a considerable up-front cost impact to the university, with the energy conservation measures and combined heat and power plant totaling $540 million in CAPEX by themselves. These, and the other noted

recommendations above, should generate a combined net savings to the university over the course of their lifecycle, but the initial capital investment needs to be planned and budgeted before moving any individual project forward.

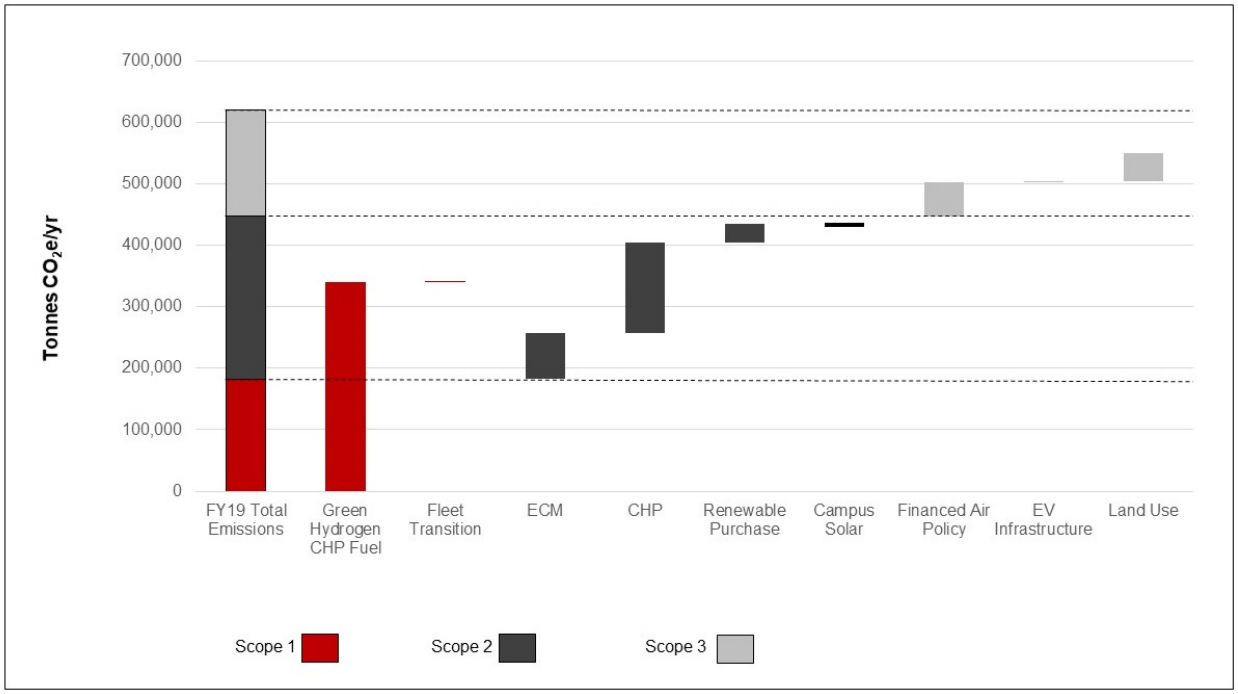

Figure 19: Multi-Solution Approach to Carbon Neutrality, Scenario 1.

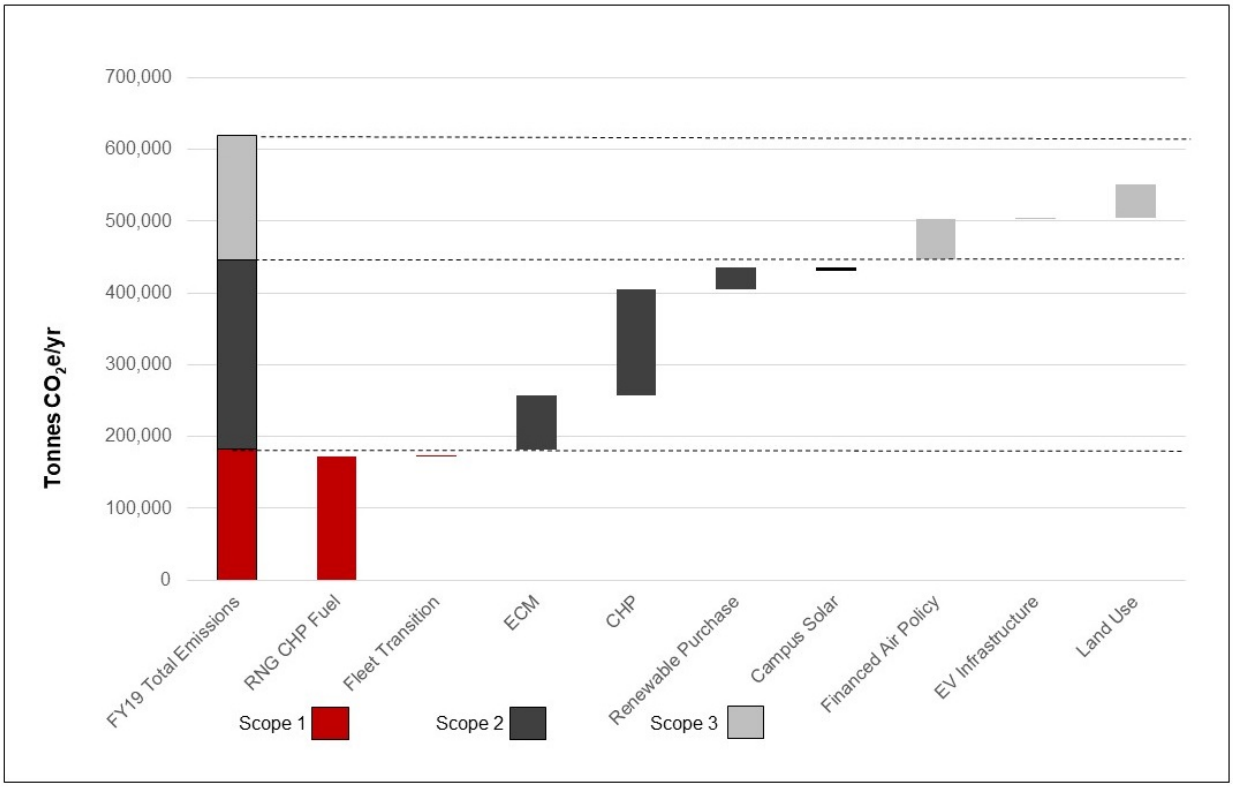

Figure 20: Multi-Solution Approach to Carbon Neutrality, Scenario 2.

VII. Challenges

While the recommended actions within this Plan outline the possibility of achieving carbon neutrality, a number of challenges exist in front of the university.

Future Growth

The university is a dynamic entity with continued growth in population and built environments expected for the forseeable future. Ohio State's Framework 2.0 plan is a considerable projection for the anticipated built environment growth at the Columbus campus. Similar planning is currently being initiated at the university's other campuses. These new building assets and academic and research offerings will attract an expanded population of students, staff, and faculty to the university over time.

As noted above, the university's greenhouse gas inventory is highly impacted by the buildings and operations of the university, as well as those who interact with the campus. If the university only focuses on reducing existing emissions through efficiencies, but continues to undertake activities that increase the total amount of carbon-emitting activities, the university will never achieve its carbon neutrality goal.

It is therefore critical that the university aggressively avoid creating new emissions whenever possible as it continues to grow. This includes designing new buildings to meet better energy use standards that will prevent the generation of unnecessary new emissions, as recommended above through a revised Green Build and Energy Policy.

While this Plan acknowledges the estimated increased energy use demand associated with the university's *Time and Change: Building the Future* projects, it does not account for additional anticipated growth within the Framework 2.0 plan and any related campus population growth over the next few decades. The integrated plan demonstrated in Figure 19 could accommodate an increase in emissions associated with new building and population growth, while still achieving the carbon neutrality goal. However, this will be an ongoing issue to monitor and incorporate into future planning.

Technology and Infrastructure Leap

Clearly, the recommendation that would mitigate the largest single amount of greenhouse gas emissions – converting a combined heat and power plant to a green hydrogen fuel source – requires the advancement of technology and logistic infrastructure that does not currently exist at the necessary scale to make the switch.

While this opens the possibility for new innovation and research collaboration for the university and its key energy partners, there is risk in pinning the university's goal achievement to an unpredictable outcome. That said, this should provide the university and its energy partners additional drive to address this topic, which could have a multiplier benefit upon society beyond just Ohio State.

Institutional Leadership

As Ohio State aspires to demonstrate sustainability leadership throughout Ohio, the Midwest, and the nation, achieving carbon neutrality by 2050 may become out-of-step with that aspiration as other higher education institutions push towards more aggressive achievement timelines. In 2018, American University became the first publicly announced carbon neutral institution of higher education in the country, Duke University has targeted 2024 for its neutrality date, and other larger schools such as the University of California-Los Angeles and the University of Florida are striving to achieve neutrality by 2025.

While there are obvious differences between institutions relevant to size and geography, and even defined scope, that will impact any single institution's ability to achieve carbon neutrality, it is clear from published research that society must address its overall greenhouse gas emissions by 2030 to avoid drastic impacts to humanity and the planet.

Institutions that wait another twenty years beyond that date to achieve neutrality will be hard pressed to position themselves as leaders. For an institution of the size and complexity of Ohio State, that may necessitate accelerated decision making or alternative options (such as purchased credit offsets) from the recommendations contained within this Plan.

VIII. Aligning Ohio State's Academic Mission

The primary purpose of this Climate Action Plan is to address the university's physical greenhouse gas emission outputs. As a land-grant institution, however, the primary mission of Ohio State is to educate citizens and demonstrate new research innovations that address society's challenges.

Since the university's original Climate Action Plan, the university has embedded its efforts into the full range of university activities. Moving forward, the university aims to continue to increase the meaningful interaction between the university's operations and its academic and research community for value-added sustainability results and findings.

At a leadership level, the President and Provost's Council on Sustainability is an interdisciplinary body made up of faculty, staff and students that provides strategic review and advice on issues related to the integration of sustainable practices, programs and projects across the university's goals.

Further, the university's sustainability goals align with its core institutional pillars:

1. Teaching and Learning
2. Research and Innovation
3. Outreach and Engagement
4. Resource Stewardship

There are numerous operational and academic departments across the university that are working independently and in partnership to advance the established sustainability goals, including carbon neutrality. Through these actions, Ohio State hopes not only to achieve sustainable operational success, but to cultivate new sustainability leaders and innovations that drive society forward.

Teaching and Learning: Student Opportunity

Sustainability Goal 1: Deliver a Curriculum that provides Ohio State students at all stages of instruction – from General Education to professional and technical programs – with opportunities to understand sustainability holistically, framed by the environment, science, technology, society, the economy, history, culture, and politics.

Sustainability Goal 2: Address the Complexities of Sustainability through a variety of learning formats, strategies, and occasions.

Students from across the globe have entrusted the Ohio State University to deliver the learning opportunities that will propel them into successful careers and leadership positions post-graduation. While the university helps students build the educational platform they will launch from into the world, the university is compelled to demonstrate a commitment to the health, well-being, and success of its students long after they leave campus.

This includes developing a context to understand and respond to local and global sustainability challenges, particularly the growing climate concerns they are entering into.

To meet these goals, the university has created the Environment, Economy, Development & Sustainability (EEDS) major for undergraduate studies. With over 200 graduates, this curriculum has been a successful partnership between the university's School of Environment and Natural Resources, AEDE and the Fisher College of Business. Based on student demand for this academic programming, an EEDS minor is also available for undergraduate studies.

Further, in the spring of 2019, the university's Board of Trustees endorsed an historic new approach to undergraduate education that will bolster a student's ability to become a citizen leader. Through this action, beginning with the 2020-2021 academic year, the university's General Education curriculum requirements will include a sustainability theme. This will help students of all backgrounds and academic disciplines gain direct knowledge of sustainability challenges while providing an opportunity for them to consider how to meet those challenges from their own experiences.

Ohio State already offers over 1,200 undergraduate and graduate level courses that include sustainability learning, a figure that is expected to increase through the adopted General Education curriculum changes.

In addition, project-based learning for students of all levels is currently occurring across the university on a variety of sustainability topics. By the end of 2020, the university's Sustainability Institute aims to formalize a campus as living lab program to catalog existing student learning projects, spur new interdisciplinary research partnerships, and advance student's understanding of how sustainability efforts are successfully implemented. One recent project example includes a collaboration between the university's Byrd Polar and Climate Research Center and Department of Geography, funded with a grant from the Sustainability Institute, to teach Geography students how to measure and study the university's own urban heat island effect. The results of the student's work will be incorporated into the univeristy's Ecosystem Services Index, which is a measurement tool the university's operating staff are using to document the environmental and social performance of the university's grounds and landscapes.

Beyond the classroom, Ohio State offers a rich environment for students to integrate themselves with sustainability learning initiatives. Some of these are more university-structured from the Environmental Professionals Network programming, to sustainability-oriented study abroad opportunities, to the SUSTAINS Learning Community. Additional opportunities are more student-driven, including the annual Time For Change Week programming and the 80+ active student organizations conducting different sustainability projects throughout the academic year.

Finally, aligned with the university's goal to ensure affordable access to a higher education degree, Ohio State has implemented a new full-tuition and board scholarship for undergraduate students whose studies focus on sustainability topics but face financial need. The university also now provides fellowships and one-time incentives for

graduate students focusing on sustainability topics. Both offerings represent just one positive outcome from the university's academic collaboration within the larger Comprehensive Energy Management Project agreement with Ohio State Energy Partners.

Research and Innovation: Faculty Opportunity

Sustainability Goal 3: Reward Sustainability Scholarship, including the scholarship of engagement, by providing incentives for students, faculty and staff to make discoveries and stimulate creative efforts that promote and achieve sustainability.

Sustainability Goal 4: Magnify Sustainability Scholarly Output and Impact to create new knowledge, solve real world problems, including for our own operations, and increase Ohio State's national/international reputation as a sustainability research leader.

A comprehensive approach to sustainability research is only possible at an institution with the size and diversity of Ohio State. The university brings scholars together – working on a wide range of research and technological innovations – to discover new approaches and solutions to persistent problems. Ohio State is a leader in key areas including climate change, behavioral science, environmental economics, resilient infrastructure design, materials and energy technology innovation, and environmental health sciences.

Today, major challenges facing society include sustainable food and water production, climate change, and accelerating urbanization. The land-grant mission of Ohio State drives discovery and knowledge enhancement in order to achieve significant advances for public well-being. The university houses over 500 faculty and researchers, representing 11 colleges and 64 academic departments, who study sustainability issues. Since 2014, the university has hired 60 faculty through the Discovery Themes Initiative, with the specific charge of contributing to sustainability and resilience research, teaching, and collaboration.

For many years, Ohio State researchers have led the world's understanding of and solutions for the changes we are experiencing across the globe. Take, for example, Byrd Polar and Climate Research Center's efforts to collect, analyze, and maintain ice cores from around the world, providing long-term understanding of earth's climate. Given that some of the locations Byrd has studied, and continues to maintain physical evidence from, no longer exist because they have melted away, this foundational work is nothing short of heroic.

In addition, Ohio State Professor Rattan Lal was recently awarded the prestigious Japan Prize for his groundbreaking research on how agricultural lands could sequester more carbon in the planet's soils, which would improve soil health and benefit agricultural productivity to feed a growing population.

In the coming months and years, the university's support for new climate related research and innovation will continue to grow, also thanks to the academic collaboration within the Comprehensive Energy Management Project agreement. While that

agreement has already endowed five faculty chair positions primarily focused on energy use issues, perhaps more visionary will be the establishment of a new Energy Advancement and Innovation Center (EAIC). A cornerstone of new research development at the university's Columbus West Campus, the EAIC will bring Ohio State research work together with private sector partners to advance lab findings into new, socially beneficial energy efficiencies and climate related advancements.

Outreach and Engagement: Community Opportunity

Sustainability Goal 5: Foster Campus-to-Community, Students-to-Alumni Culture of sustainability-oriented practices and educational and research experiences that students and alumni transfer into local and global communities.

Sustainability Goal 6: Catalyze Engagement, Ownership, and Buy-In to Sustainability via engaged and inclusive partnerships, on and off campus that support the long-term economic, social and environmental welfare of the campus, surrounding neighborhoods and the global community.

Durable solutions to sustainability challenges require community engagement and lasting partnerships with stakeholders. Ohio State has a long history of engaging urban and rural communities in ways that are highly responsive to their needs and interests. OSU Extension reaches all of Ohio's 88 counties, while the university's faculty have relationships throughout the Midwest, nation, and the world. Ohio State strives to develop solutions that promote social equity and ensure that enjoyment of the benefits from sustainability is widespread.

Leveraging the university's expertise and knowledge gained from on-campus operational experimentation, Ohio State has the capability to help others achieve their own greenhouse gas emission reduction goals. In doing so, the university could have a physical impact of much greater importance than achieving its own carbon neutrality goal.

There are numerous ways to demonstrate the university's climate-related community engagement and partnership building, but three recent efforts exemplify the diversity of engagement:

1. **Columbus Climate Adaptation Plan.** With the help of Byrd Polar and Climate Research Center experts, the City of Columbus issued its first climate adaptation plan in December 2018. Over the course of four years, city, regional, and Ohio State leaders assessed climate change impacts, risks, and vulnerabilities in Columbus. Engaging a wider community audience for feedback and input, the plan identifies 43 prioritized actions for the city to take to protect its citizens in the wake of expected climate changes.
2. **Smart Columbus.** In 2016, the City of Columbus was awarded $50 million in grant funding and the designation as America's Smart City as the winner of the U.S. Department of Transportation's (USDOT) first-ever Smart City Challenge. The goal of Smart Columbus is to embrace the reinvention of transportation in the city so as to improve the quality of life, drive economic growth, and foster

sustainability. Ohio State was named the primary research partner to Smart Columbus, and has leveraged a $2 million cash commitment by the university to engage faculty, staff, and students in Smart Columbus deliverables. Just one example of this significant partnership is the ongoing effort of Ohio State's Environment, Economy, Development and Sustainability (EEDS) capstone course students to provide private and public sector partners with research projects that advance the Smart Columbus objectives. With projects including municipal and private sector electric vehicle fleet adoption strategies as well as increasing renewable energy sources to power electric vehicle recharging, Ohio State students and their faculty mentors are providing many necessary research needs to help the Central Ohio community reduce its overall transportation related greenhouse gas emissions. In turn, the students gain valuable experience in team-oriented, project-based learning to advance sustainability outcomes in a dynamic urban setting.

3. **University Climate Change Coalition.** Launched in February 2018, the University Climate Change Coalition (UC3) seeks to accelerate local greenhouse gas reduction efforts through the collective research expertise of 20 leading climate research institutions across North America. As one of the Coalition's founding institutions, throughout 2019, Ohio State has led the group's effort to develop a joint white paper on carbon pricing in order to share the value of such a tool with public policy leaders.

Ohio State students, faculty, and staff regularly interact with private, public, and non-profit sector partners to address many facets of climate mitigation and adaptation. From campus and community based tree plantings, to integrating the electrification of the transportation sector, to helping the agricultural sector plan for changing growing zones while increasingly sequestering more carbon through management activities, Ohio State looks to partner in comprehensive ways to help bring more diverse climate solutions forward.

Resource Stewardship: Campus Opportunity

Sustainability Goal 7: Implement specific, "world-leading" university-wide operational goals to reduce resource consumption, neutralize carbon emissions and minimize waste, including:

a. Achieve carbon neutrality by 2050 per American College and University Presidents Climate Commitment [Presidents' Climate Leadership Commitment]
b. Reduce total campus building energy consumption by 25% by 2025
c. Reduce potable water consumption by 5% per capita every five years, resetting baseline every five years
d. Increase campus ecosystem services by 60% by 2025
e. Reduce carbon footprint of university fleet by 25% by 2025
f. Achieve zero waste by 2025 by diverting 90% of waste away from landfills
g. Increase production and purchase of locally and sustainably sourced food to 40% by 2025

h. Develop university-wide standards for targeted environmentally preferred products and fully implement preferable products and services by 2025

Achieving many of these resource stewardship goals will help the university address its own greenhouse gas emissions. As importantly, they will help Ohio State develop its own solutions to the pressing challenges of sustainability and evolve a culture of sustainability within the university's diverse group of stakeholders. Collaborative teaching, pioneering research, comprehensive outreach, and innovative operations, practices, and policies will help Ohio State demonstrate to others how environmental, economic and social goals can be mutually achieved.

IX. Future Considerations

Future Ohio State Climate Action Plans should consider accounting university emissions by sector or department so different aspects of campus can track their own progress, such as university operated hospitals, student residences and athletic facilities.

Increasing the quality of data collection across the university's campuses, particularly those outside of the flagship Columbus campus, needs to remain a priority to continually increase the accuracy of the greenhouse gas emissions inventory.

To increase the viability of carbon sequestration opportunities on university owned lands, the existing tree inventory conducted on the Columbus campus should be expanded to all campuses. In addition, soil data across all campuses should be assessed on the three identified land types referenced above: cropland, grassland and forest. These efforts would increase knowledge of both the existing amount of carbon sequestered on university properties and how to manage those properties to further increase sequestration levels.

Finally, as a research institution, it is important to explore future research needs for campus sustainability, such as the intersection of technology, ecology, behavior and economics to devise approaches for the future. Meeting the goal of carbon neutrality is no small task and will take the cooperation and ambition of the entire Ohio State community.

As noted in this Plan's Executive Summary, the Intergovernmental Panel on Climate Change's (IPCC) fifth assessment found that limiting global warming to 1.5 degrees Celsius requires "rapid and far-reaching" action. There will need to be drastic changes to the infrastructure and operation of our cities, buildings, transportation, energy, manufacturing and land use. This shows the need for Ohio State to take urgent action now, as well as the importance of the university fulfilling its commitment to carbon neutrality, in collaboration with people, organizations and universities across the world.

X. Appendix

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